INFRARED RADIOMETRY OF 10: THERMAL, ANOMALIES AND HEAT FLOW FOR THE PAST DECADE; G. J. Veeder, D. L. Blaney, D. L. Matson, T. V. Johnson, and J. D. Goguen, Jet Propulsion Laboratory, California Institute of Technology, MS 183-501, 4800 Oak Grove Drive, Pasadena, CA 91109.

Infrared radiometry of Io as a function of longitude and time at 4.8, 8.7and2.O/mean characterize the temperatures, the spatial distribution, and the temporal evolution of thermal anomalies. 'l'his information can then be used to determine the heat flow from 10. 10's heat flow is a strong constraint on possible models for the interior of 10 and the history of 10's orbital evolution (e.g. 1, 2, 3). For this reason, it is a fundamental physical quantity in the Jovian system whose value needs to be accurately determined.

This paper presents data collected at the NASA IRTF from 1983 to 1993. Unimproved background model has enabled us to determin e geothermal power from Io for this period. 'l'he total power and the power from the leading and trailing hemispheres at-c show in **figure 1**. Roughly equal amounts of power are emitted from both the leading and trailing hemisphere in spite of the locat ion on the trailing hemisphere of 1 ,oki (the single largest volcanic center on 10). Addit ionall y, although thermal emission at 4.8 μm is highly variable, *the total power output has been relatively stable over the last decade.* Contrasting the. 1993 measurements with earlier measurements illustrate this.]n 1993, thermal emission from 1 ,oki at 4.8 μm was extremel y low, however, the power emitted from 10's surface was at roughly the same level as during the 1989-1990 apparition when Loki was undergoing a 4.8 μm brightening.

The new background model has led to the identification of new, "warm" (< 200K) thermal anomalies. Detection of these relatively low temperature thermal regions requires radiometry at 10 and 20 μm. As can be seen in **figure 2**, most of the power is coming from these large "warm" regions.

Using the data in **figure 1**, we estimate the average heat flow for Io during the decade is greater than 2.55 W/m^2. This lower limit is significant y larger than our previous estimates of about 2 W/m^2 (e.g. 4), a value typical of active geothermal areas on the Earth. We have assumed that all thermal regions for which we do not have latitudinal information from Voyager arc located at the equator. Because of projection effects, locating thermal anomalies at the equator minimizes estimates of heat flow. Similar high heat flow values have been estimated based on recent analysis of Voyager 1 RIS spect ra (5).

The power was determined by using a 5 source thermal model (the minimum we need to match the lightcurves). 'l'he locations and albedos of known Voyager sources were used on the trailing hemisphere. Areas and temperatures of spots were fitted by calculating the flux at 4,8, 8,7, and 20 μm and matching the flux to the orbital lightcurves. **Figure 3** shows the regional power output as a function of longitude. (a wrapped plot is shown for convenience) over the last decade. Power for each of the 5 thermal regions for each apparition is shown using the following symbols: 1983- cross; 1984 - half moon; 1985 - asterisk; 1986- X; 1987 - solid circle; 1988-9- square; 1989-90- triangle; 1992- diamond; 1993- open circle. An interesting point in this figure is that in most apparitions, significantly more power is emitted from the Jupiter facing hemisphere than the anti-Jupiter hemisphere. Detailed information about the characteristics and history of each of these thermal regions will also be presented. This work was performed under cont ract to NASA at the Jet l'repulsion Laboratory.

References: 1. Fischer, H. J., and T. Spohn (1990), *Icarus* **83**, 39-65; 2. Ross, M. M., G. Schubert, T. Spohn, and R. W, Gaskell (1990), *Icarus* 85, 309-32.5; 3. Segatz, M,, T. Spohn, M. N. Ross, and G. Schubert (1988), *Icarus* 7S, 187-2.06; 4. Matson, D. L., G. Ransford, and T. V. Johnson (1980), ***J. Geophys. Res.*,86,** 1664-1672; 5. McEwen, A. S., N. R. Isbell, and J. C. Pearl (1992), (abstract), *Lunar and Planetary Science* ***XX1/f,881.***

Fig. 1 Total and Hemispheric Power

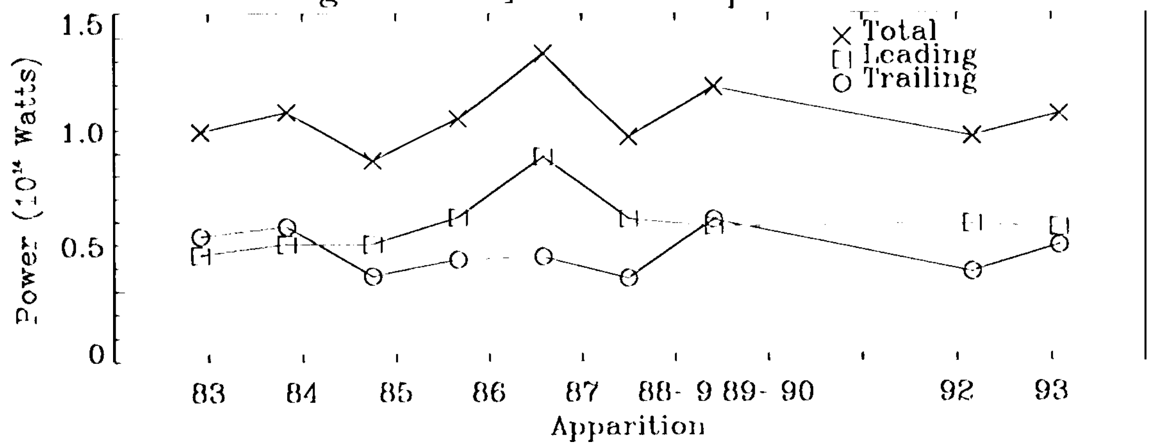

Fig. 2 Power from Thermal Anomalies

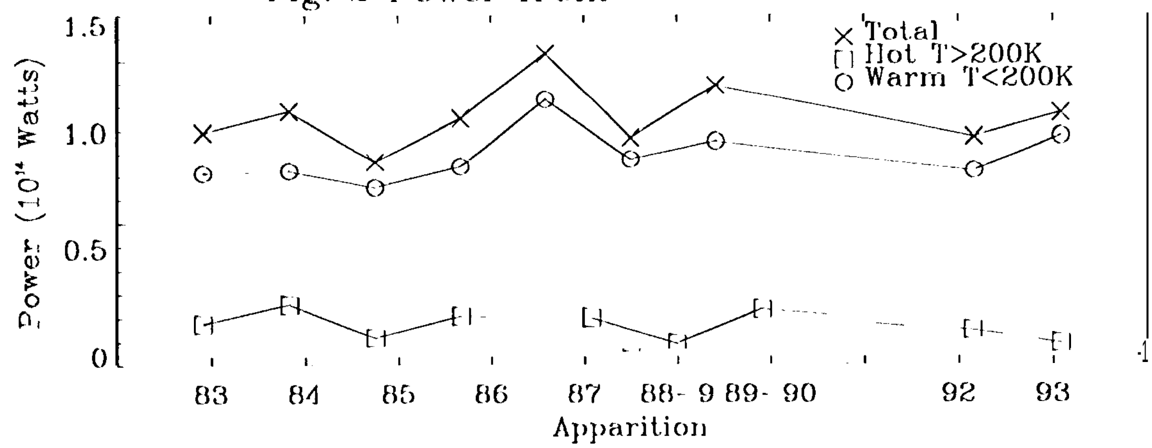

Fig. 3 Regional Power Output on Io